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09/692,470	10/20/2000	Shinji Yamamoto		6675

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EXAMINER
NGUYEN, TU MINH

ART UNIT	PAPER NUMBER
3748	21

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/692,470	Applicant(s) Yamamoto et al.
	Examiner Tu M. Nguyen	Art Unit 3748

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Mar 6, 2003* .

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1, 2, 5-10, and 12-36* is/are pending in the application.

4a) Of the above, claim(s) *7-10 and 12-14* is/are withdrawn from consideration.

5) ☒ Claim(s) *19-22* is/are allowed.

6) ☒ Claim(s) *1, 2, 5, 6, 15-18, 23-33, 35, and 36* is/are rejected.

7) ☒ Claim(s) *34* is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☒ The proposed drawing correction filed on *Jan 3, 2002* is: a) ☒ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) ☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☒ All b) ☐ Some* c) ☐ None of:

1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). *20*
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. An Applicant's Request for Continued Examination (RCE) and an Applicant's Amendment filed on March 6, 2003 have been entered.

Claim 4 has been canceled. Claims 1, 18, 28-30, and 33-35 have been amended. Overall, claims 1, 2, 5-10, and 12-36 are pending in this application.

2. In the response to the restriction requirement mailed on January 11, 2002, applicant elected on May 31, 2002 (Paper No. 10) the species of Figure 2 ~~with~~ without traverse. Claims 5, 6, 15-23, and 31-36 are readable on the species of Figure 2. Claims 1, 2, and 24-30 are generic. Thus, claims 1, 2, 5, 6, and 15-36 will be examined in its full merit. Claims 7-10 and 12-14 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Drawings

3. The amended drawings filed on January 3, 2002 have been approved for entry. Upon allowance of the pending application, formal drawings with the approved changes must be submitted.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1, 2, 18, and 26-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oshima et al. (U.S. Patent 5,412,946).

Re claims 1, 28-30, and 33, as shown in Figure 9, Oshima et al. disclose an exhaust gas purifying system and an exhaust gas purifying method of a multiple step control type in combination with an internal combustion engine (119) having an exhaust gas passageway, the engine includes a combustion system having a combustion control device (the ECU is shown in Figure 1) for controlling at least one selected from the group consisting of operating parameters of the engine and combinations of the operating parameters, the operating parameters including fuel injection timing, spark timing, opening and closing timings of intake and exhaust valves of the engine. The exhaust gas purifying system includes:

- a NOx treating catalyst (12) for reducing NOx disposed in the exhaust gas passageway to reduce NOx in presence of reducing components in exhaust gas, and

- a hydrogen enriching device (120 or 9) disposed upstream of the NOx treating catalyst with respect to flow of exhaust gas and including a device (120) arranged to increase a ratio of hydrogen to total reducing components in a combustion gas,

wherein the hydrogen enriching device is a device (120) for producing hydrogen from HC and CO in a combustion gas (hydrogen and CO are generated by reacting HC with air at the device (120) (lines 49-65 of column 4); hydrogen is further produced from CO in a water shift reaction as shown on line 45 of column 7), the device (120) is a hydrogen producing catalyst containing at least one noble metal (rhodium) (line 52 of column 4).

Oshima et al., however, fail to specifically disclose that the hydrogen enriching device (120 or 9) is arranged to increase a ratio of hydrogen to total reducing components in a combustion gas so as to relations represented by the following formulae (1) and (2), when reduction of NOx is carried out by the NOx treating catalyst:

$$[H2 / TR]d > [H2 / TR]u \quad (1)$$

$$[H2 / TR]d \geq 0.3 \quad (2)$$

where [H2 / TR]u is a ratio between a concentration [H2]u of hydrogen and a concentration [TR]u of total reducing components in exhaust gas in the exhaust gas passageway upstream of the hydrogen enriching device; and [H2 / TR]d is a ratio between a concentration [H2]d of hydrogen and a concentration [TR]d of total reducing components in exhaust gas in the exhaust gas passageway upstream of the NOx treating catalyst and downstream of the hydrogen enriching device.

In the above formula (1), [H2 / TR]u is approximately zero as only a trace amount of hydrogen is produced from the combustion engine. [H2 / TR]d is equal to the ratio of {[H2]u+[H2]} and {[TR]u+[TR]}, where [H2] and [TR] are the concentration of hydrogen and total reducing components from the hydrogen enrichment device, respectively. Per molar basis, [H2]u is approximately zero; and with the second chemical reaction in column 4, [H2] and [TR] are 1 and 2, respectively. Therefore, [H2 / TR]d is equal to 1/{2+[TR]u} which is clearly greater than zero. Thus, formula (1) is obviously satisfied when the hydrogen enrichment device is active and producing a mixture containing hydrogen in accordance to the second chemical reaction in column 4. In formula (2), as shown earlier, [H2 / TR]d = 1/{2+[TR]u} and is greater than or equal to 0.3 only if [TR]u is less than 1.33 mole. It is hereby argued that [TR]u is negligible as the exhaust gas must pass through the oxidizing catalyst (9) where a majority amount of HC and CO is oxidized. Hence, formula (2) is obviously satisfied when the hydrogen enrichment device is active and producing a mixture containing hydrogen in accordance to the second chemical reaction in column 4 and when there exists an oxidizing catalyst (9) located upstream of the NOx treating catalyst (12).

Re claim 2, in the exhaust gas purifying system of Oshima et al., the hydrogen enriching device is arranged to increase a ratio of hydrogen to carbon monoxide in the total reducing components in exhaust gas so as to meet a relation represented by the following formula [H2 / CO]d > 1 where [H2 / CO]d is a ratio between a concentration [H2]d of hydrogen and a concentration [CO]d of carbon monoxide in the total reducing components in exhaust gas in the

exhaust gas passageway immediately upstream of the NOx treating catalyst and downstream of the hydrogen enriching device, when reduction of NOx is carried out by the NOx treating catalyst. In the device shown in Figure 9, as discussed above, [H2]u and [CO]u of the exhaust gas passing through the oxidizing catalyst (9) are approximately zero. Thus, [H2 / CO]d is simply equal to [H2 / CO] of the hydrogen enrichment device; and [H2 / CO]d is clearly greater than or equal to one when the hydrogen enrichment device is active and producing a mixture containing hydrogen in accordance to the second chemical reaction in column 4 and when there exists an oxidizing catalyst (9) located upstream of the NOx treating catalyst (12).

Re claim 18, in the exhaust gas purifying system of Oshima et al., the hydrogen producing catalyst (120) has a function to produce hydrogen from HC and CO in the combustion gas.

Re claim 26, the combustion device in the exhaust gas purifying system of Oshima et al. is an internal combustion engine.

Re claim 27, the internal combustion engine in the exhaust gas purifying system of Oshima et al. is a gasoline-fueled engine for an automotive vehicle (see Figure 6 and lines 53-56 of column 6).

Re claim 31, in the exhaust gas purifying system of Oshima et al., the hydrogen enriching device is a device (9) for suppressing consumption of hydrogen in exhaust gas.

Re claim 32, in the exhaust gas purifying system of Oshima et al., the hydrogen enriching device is a device (9) for decreasing the reducing components (HC or CO) other than hydrogen in the exhaust gas.

6. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Oshima et al. as applied to claim 18 above, in view of Bartley (U.S. Patent 6,244,044).

The system of Oshima et al. discloses the invention as cited above, however, fails to disclose that the system further comprises a device for controlling exhaust gas a position upstream of the hydrogen producing catalyst to intermittently have a composition in which air-fuel ratio is rich, so as to raise efficiency of production of hydrogen by the hydrogen producing catalyst.

Bartley teaches a method for reducing cold-start hydrocarbon emissions, that utilizes a hydrogen producing catalyst (16) containing rhodium for the production hydrogen in the exhaust gas during a fuel rich operation (see the Abstract and lines 17-20 of column 4). In Bartley, the controller adjusts the engine air-fuel ratio such that the exhaust gas exiting the engine has an intermittently rich air-fuel ratio so as to raise efficiency of production of hydrogen by the hydrogen producing catalyst (16). It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the method taught by Bartley in the system of Oshima et al., since the use thereof would have provided an effective means to provide additional hydrogen gas for the effective reduction of NOx emissions at the NOx treating catalyst.

7. Claims 5 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oshima et al. as applied to claim 1 above, in view of Kumar et al. (U.S. Patent 6,151,547).

Re claim 5, in the system of Oshima et al., the hydrogen enrichment device is a CO and HC selective oxidation catalyst (120) for selectively oxidize CO and HC into hydrogen. Oshima et al., however, fail to disclose that oxidation catalyst (120) further contains zirconium oxide.

Kumar et al. teach that it is conventional in the art to utilize zirconium oxide as a stabilizer and a promoter in a catalytic converter (lines 5-12 of column 16). It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized zirconium oxide taught by Kumar et al. in the oxidation catalyst (120) of Oshima et al., since the use thereof would have produced additional hydrogen in the exhaust gas so that the light-off temperature to reduce NOx in the NOx treating catalyst can be lowered.

Re claim 15, in the modified exhaust gas purifying system of Oshima et al., the CO and HC selective oxidation catalyst has a function of producing hydrogen and contains rhodium and zirconium oxide, the zirconium oxide containing alkaline earth metal and having a composition represented by the following general formula (3):

$$[X]aZrbOc \qquad (3)$$

where X is an alkaline earth metal selected from the group consisting of magnesium, calcium, strontium and barium (Kumar et al.: lines 41-48 of column 15 and lines 5-12 of column 16); a and b are ratios of atoms of elements, and c is a number of oxygen atoms required for satisfying valences of X and Zr, in which a is within a range of from 0.01 to 0.5, b is within a range of from 0.5 to 0.99, and a+b= 1.0.

8. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Oshima et al. in view of Kumar et al. as applied to claim 15 above, and further in view of design choice.

In the modified system of Oshima et al., the CO and HC selective oxidation catalyst further contains palladium and cerium oxide (line 65 of column 16 to line 39 of column 17).

Oshima et al., however, fail to disclose that the palladium is carried in an amount ranging from 20 to 80% by weight of total palladium on cerium oxide.

With regard to applicants claim directed to a specified percentage amount of the total palladium on cerium oxide, the specification of such would have been an obvious matter of design choice well within the level of ordinary skill in the art depending on design variables, such as the amount of cerium oxide, cost and availability of palladium, operating environment of the catalyst, etc . Moreover, there is nothing in the record which establishes that the specification of such presents a novel of unexpected result (See *In re Kuhle*, 526 F.2d 553, 188 USPQ 7 (CCPA 1975)).

9. Claims 6 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oshima et al. as applied to claim 1 above, in view of Kobayashi et al. (U.S. Patent 5,124,303) and Tauster et al. (U.S. Patent 4,149,998).

Re claim 6, the system of Oshima et al. discloses the invention as cited above, however, fails to disclose that the hydrogen enrichment device is a device for suppressing consumption of hydrogen in at least one of combustion gas and exhaust gas; and that the device is a catalyst containing solid acidic zirconium oxide.

Kobayashi et al. teach a catalyst for treatment of waste gas, that contains solid acidic zirconium oxide. Tauster et al. teach that catalysts that contain an oxide of zirconium is known to suppress the chemisorption of hydrogen (see the Abstract). Therefore, the catalyst in Kobayashi et al. can suppress the consumption of hydrogen in the exhaust gas. It would have been obvious

to one having ordinary skill in the art at the time of the invention was made, to have utilized the catalyst taught by Kobayashi et al. in the system of Oshima et al., since the use thereof would have provided an effective system to remove harmful emissions in the exhaust gas of internal combustion engines.

Re claim 17, in the modified exhaust gas purifying system of Oshima et al., the catalyst containing solid acidic zirconium oxide contains platinum, the solid acidic zirconium oxide containing at least one element selected from the group consisting of titanium, aluminum tungsten, molybdenum and zinc, the solid acidic zirconium oxide having a composition represented by the following general formula (4):

$$[Y]dZreOf \qquad (4)$$

where Y is at least one element selected from the group consisting of titanium, aluminum, **tungsten**, molybdenum and zinc; d and e are ratios of atoms of elements; and f is a number of oxygen atoms required for satisfying valences of Y and Zr, in which d is within a range of from 0.01 to 0.5, e is within a range of from 0.5 to 0.99, and d+e = 1.0 (see Example 3 in Kobayashi et al.).

10. Claims 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oshima et al. as applied to claim 1 above, in view of Kaneko et al. (U.S. Patent 6,173,571).

Re claim 24, the NOx treating catalyst of Oshima et al. cited above contains platinum. Oshima et al., however, fail to disclose that the NOx treating catalyst also contains at least one substance selected from the group consisting of alumina, alkali metal and alkaline earth metal.

Kaneko et al. teach that it is conventional in the art to utilize a NOx treating catalyst containing at least one substance selected from the group consisting of alumina, alkali metal and alkaline earth metal (lines 10-16 of column 8). It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the NOx treating catalyst taught by Kaneko et al. in the system of Oshima et al., since the use thereof would have provided an effective NOx treating catalyst to purify exhaust gas from internal combustion engines.

Re claim 25, in the exhaust gas purifying system of Oshima et al., the NOx treating catalyst contains at least rhodium (Kaneko et al.: lines 10-16 of column 8) and arranged to be capable of reducing NOx in exhaust gas at a temperature ranging from 260 to 380°C (Oshima et al.: curve B in Figure 19).

11. Claims 35 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oshima et al. in view of Bartley.

Re claim 35, as shown in Figure 9, Oshima et al. disclose an exhaust gas purifying system, comprising:

- a NOx treating catalyst (12) for reducing NOx disposed in the exhaust gas passageway to reduce NOx in presence of reducing components in exhaust gas, and

- a hydrogen enriching device (120 or 9) disposed upstream of the NOx treating catalyst with respect to flow of exhaust gas and including a device (120) arranged to increase a ratio of hydrogen to total reducing components in a combustion gas,

wherein the hydrogen enriching device is a device (120) for producing hydrogen from HC and CO in a combustion gas (hydrogen and CO are generated by reacting HC with air at the device (120) (lines 49-65 of column 4); hydrogen is further produced from CO in a water shift reaction as shown on line 45 of column 7), the device (120) is a hydrogen producing catalyst containing at least one noble metal (rhodium) (line 52 of column 4).

Oshima et al., however, fail to specifically disclose that the hydrogen enriching device is arranged to increase a ratio of hydrogen to total reducing components in a combustion gas so as to relations represented by the following formulae (1) and (2), when reduction of NOx is carried out by the NOx treating catalyst:

$$[H2 / TR]d > [H2 / TR]u \quad (1)$$

$$[H2 / TR]d \geq 0.3 \quad (2)$$

where [H2 / TR]u is a ratio between a concentration [H2]u of hydrogen and a concentration [TR]u of total reducing components in exhaust gas in the exhaust gas passageway upstream of the hydrogen enriching device; and [H2 / TR]d is a ratio between a concentration [H2]d of hydrogen and a concentration [TR]d of total reducing components in exhaust gas in the exhaust gas passageway upstream of the NOx treating catalyst and downstream of the hydrogen enriching device.

Moreover, Oshima et al. also fail to disclose that both the NOx treating catalyst and the hydrogen enriching device are disposed in the exhaust passageway and wherein exhaust gas passes through the hydrogen enriching device.

In formula (1), [H2 / TR]u is approximately zero as only a trace amount of hydrogen is produced from the combustion engine. [H2 / TR]d is equal to the ratio of {[H2]u+[H2]} and {[TR]u+[TR]}, where [H2] and [TR] are the concentration of hydrogen and total reducing components from the hydrogen enrichment device, respectively. Per molar basis, [H2]u is approximately zero; and with the second chemical reaction in column 4, [H2] and [TR] are 1 and 2, respectively. Therefore, [H2 / TR]d is equal to 1/{2+[TR]u} which is clearly greater than zero. Thus, formula (1) is obviously satisfied when the hydrogen enrichment device is active and producing a mixture containing hydrogen in accordance to the second chemical reaction in column 4. In formula (2), as shown earlier, [H2 / TR]d = 1/{2+[TR]u} and is greater than or equal to 0.3 only if [TR]u is less than 1.33 mole. It is hereby argued that [TR]u is negligible as the exhaust gas must pass through the oxidizing catalyst (9) where a majority amount of HC and CO is oxidized. Hence, formula (2) is obviously satisfied when the hydrogen enrichment device is active and producing a mixture containing hydrogen in accordance to the second chemical reaction in column 4 and when there exists an oxidizing catalyst (9) located upstream of the NOx treating catalyst (12).

Bartley teaches a method for reducing cold-start hydrocarbon emissions, that utilizes a hydrogen producing catalyst (16) containing rhodium for the production hydrogen directly from the rich components in the exhaust gas during a fuel rich operation (see the Abstract and lines 17-20 of column 4); wherein the exhaust gas passes through both the hydrogen producing catalyst (16) and a main catalyst (14) in a passageway. It would have been obvious to one having

ordinary skill in the art at the time of the invention was made, to have utilized the hydrogen producing catalyst taught by Bartley in the system of Oshima et al., since the use thereof would have provided an effective means to provide additional hydrogen gas for the effective reduction of NOx emissions at the NOx treating catalyst.

Re claim 36, in the modified exhaust gas purifying system of Oshima et al., the hydrogen enriching device (9) is arranged to increase a ratio of hydrogen to carbon monoxide in the total reducing components in exhaust gas so as to meet a relation represented by the following formula [H2 / CO]d > 1 where [H2 / CO]d is a ratio between a concentration [H2]d of hydrogen and a concentration [CO]d of carbon monoxide in the total reducing components in exhaust gas in the exhaust gas passageway immediately upstream of the NOx treating catalyst (12) and downstream of the hydrogen enriching device (9), when reduction of NOx is carried out by the NOx treating catalyst (this is obvious because the hydrogen enriching device (9) oxidizes the CO in the exhaust gas and thus, the concentration of CO is nearly zero at a location upstream of the NOx treating catalyst and downstream of the hydrogen enriching device).

Allowable Subject Matter

12. Claims 19-22 are allowed.

Claim 34 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Prior Art

13. The IDS (PTO-1449) filed on March 27, 2003 has been considered. An initialized copy is attached hereto.

Communication

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Tu Nguyen whose telephone number is (703) 308-2833.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Thomas E. Denion, can be reached on (703) 308-2623. The fax phone number for this group is (703) 872-9302. For After Final communication, the fax phone number is (703) 872-9303.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-1148.

Tu M. Nguyen

TMN

July 10, 2003

Tu M. Nguyen

Patent Examiner

Art Unit 3748